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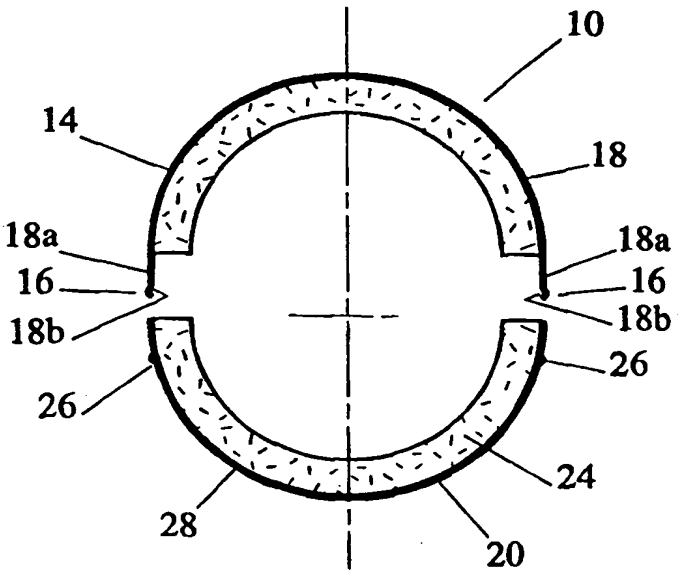
(57) Abstract

A pre–formed insulation module (10) having a part–cylindrical body including: an unstriated insulation layer (14) comprising a rigid insulating material and being substantially uniform in composition and density over a cross section of said layer (14); an inner surface adjacent to a surface of a component to be insulated; an outer surface generally concentric to said inner surface and contacting surfaces; a substantially non–fibrous resilient cladding layer (18) shaped to the body and directly adhered to the insulation layer (14) at the outer surface; and connection means (16) disposed along the length of the body for connecting with a further insulation module (2) wherein the insulation and cladding layers of each module (10; 20) are brought into relative contact along said contacting surfaces of the modules (10; 20) to insulate a portion of the component.



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INSULATION MODULE, SYSTEM AND METHOD FOR INSTALLATION AND MANUFACTURE

This invention relates to an insulation module; a system of modules for insulating a component; a method of installation of the insulation modules; and a method of manufacture of the insulation module.

The purpose of insulation is well known, it is to reduce the impact of ambient environmental conditions on desired temperature within the insulated environment by reducing the heat transfer driving force between the insulated and ambient environments. The insulation operation involves the location and fastening of layer(s) of insulating materials, which may be of the same or different nature, about the component to be insulated. The installation may involve wrapping of an insulating material about the component but other constructions, for example panel constructions, which are adhered or otherwise secured to the component may also be employed.

In the industrial context, the object of insulation of a component is to maintain a desired temperature within that component. Thus in a chemical plant, tanks and pipes may hold or carry materials such as solids, gases or liquids which must be maintained within controlled temperature limits for efficient use within the process being conducted within the chemical plant.

Achievement of this objective is directly linked to the cost efficiency of the chemical plant as heating and cooling costs may be substantial and may be reduced by effective insulation to prevent heat loss or gain from the insulated component.

Insulation of a chemical plant is an expensive process. Generally, it has involved the installer in the transport of the necessary cladding and insulation materials to the site where it is then manufactured into the desired form to complete the insulation job. Therefore, the process is time consuming and requires a great deal of organisation to be competently and cost effectively carried out.

Further, there are some insulation materials which, though highly suitable for the purpose of insulation, are nevertheless considered to pose such a risk to the workers on a site that all non-insulation work must cease while the insulation

is installed. This may necessitate working in night environments where the costs of lighting and incidental costs of employment are commensurately higher than during the day.

Typical of such insulation materials are fibres, particularly man-made materials such as synthetic or natural mineral fibres. One such fibre typically used in chemical plants is fibreglass. The work restraints described above are very pertinent to this fibrous material.

It is the object of the present invention to provide insulation modules, systems and methods for the installation of these which avoid, to the maximum practical extent, the cost and safety disadvantages of current techniques while achieving the insulation objective.

With this object in view, a first aspect of the invention provides a pre-formed insulation module having a part-cylindrical body including:

an unstriated insulation layer shaped to the body comprising a rigid insulating material and being substantially uniform in composition and density over a cross section of said layer; an inner surface adjacent to a surface of a component to be insulated; an outer surface generally concentric with said inner surface; and contacting surfaces;

a substantially non-fibrous resilient cladding layer shaped to the body and directly adhered to the insulation layer at the outer surface thereof; and

connection means disposed along the length of the body for connecting with a further insulation module wherein said insulation and cladding layers of said module are disposed relative to each other such that, on connection to said further insulation module, insulation layers of said module and said further module are brought into contact along said contacting surfaces of the modules for insulating a portion of the component and wherein, when said insulating material is a fibrous material, fibres thereof are sealed by a sealing agent and are not specifically oriented relative to the modules.

By pre-formed is meant that the insulation module may be manufactured, as a complete insulating article, prior to transfer to, and installation at, a factory site. The factory site may be very remote to the site where the manufacturing plant is located. Such pre-fabrication of modules, which may be installed directly

at the site, saves significant site costs and reduces the cost of the insulation project.

The insulating material is typically a fibrous material. Fibres may be synthetic or natural and man-made mineral fibres are especially contemplated within the scope of the present invention. Non-fibrous cellular materials such as polyurethane may be used as insulating material. The material may take any suitable rigid or flexible form, for example panels, mattresses or blankets.

Suitable materials may be selected from fibrous materials in rigid form, rigid polyurethane foam and polyisocyanurate foam. Modules may be designed with insulation materials suitable for high temperature applications as might be encountered in chemical plants and oil and gas refineries and installations where temperatures may be required to be maintained in excess of the boiling point of water.

The pre-formed module may be made up of any desired number of insulating layer(s) and any desired number of cladding layer(s). The insulating layers must include at least one layer of a fibrous material, but may include further layer(s) of insulating materials of same or different nature. Insulation materials may be blended together. The construction of the pre-formed module will be dependent upon the nature of the insulation job and the cost acceptability of the module.

Preferably, the insulation module is provided with means to connect the module with another such module. Thus, in the case where the component to be insulated is a pipe or pipe fitting, such as an elbow or T-joint, a pre-formed module may cover a portion of the pipe or pipe fitting. That module is connected to another module or series of modules to complete the insulation of the pipe or pipe fitting.

Conveniently, the modules in this instance may be semi-cylindrical in geometry though the module may be a fractional cylinder of any desired circumferential extent. It may be found that semi-cylindrical modules are suitable for insulation of pipes to about 20" diameter, above that diameter the modules may be made a lesser fraction of a cylinder in circumference. That is it may be found more convenient to use more than two modules to insulate a

length of pipe. It will be understood that the module need not be limited in its application to the insulation of pipes and may not be circular or part circular.

In an advantageous embodiment, the pre-formed insulation module is a semi-cylindrical module with cladding layer overlapping the insulation layer along the length of the module on both sides of a longitudinal axis thereof such as to overlap with a cladding layer of a further module for at least partial connection therewith for insulating a component. The module may be provided along its length with circumferential beads and/or longitudinally extends to assist in connection to further modules for insulation of a component to be insulated.

Many components such as tanks may be insulated using similar pre-formed modules which need not be at all cylindrical in geometry. The determining factors in selection of the design of the module are as follows: the geometry of the component to be insulated, insulation requirements and cost.

The sealing agent sealing the mineral fibres must be such as to substantially contain the fibres in normal use, that is substantially preventing environmentally unacceptable (as dictated by standards or regulations) escape or detachment of fibres, during normal use. Many sealing agents may be suitable for this application, typically allowing a rigid fibrous material to be produced. They may be sprayed or otherwise applied to the mineral fibre product sourced from the mineral fibre supplier to achieve sealing. An acrylic emulsion has been found to be a suitable agent which is applied to the mineral fibre product by spraying.

The module may be manufactured in any convenient manner but generally the fibrous insulating material is cut to shape, that is the shape of the component, or part of a component to be insulated, sealed with the sealing agent and then adhered to a cladding material.

The cladding material may be formed from a metal such as stainless steel, coated steel or aluminium; or a polymeric material. The cladding material could be a composite material. It should be resistant to environmental and plant conditions. Typically, the cladding material would be formed into a resilient part-cylindrical sheet, that maintains some degree of resilience following fabrication

into pre-formed modules. The cladding requires both temperature and corrosion resistance. It is directly adhered to the insulating layer by adhesives or other means. Possibly the sealing agent for sealing the matrix of material may be used as the adhesive agent.

The insulation module may be secured into position by fitting onto the component to be insulated, advantageously directly contacting it. The fitting should take account of any thermal expansion and contraction of the insulated component. The module may also be provided on the inner surface of the insulating layer with connection means which connect it to the component, or a part of the component to be insulated. Modules can be interference or otherwise fitted together. Resilience of the cladding layer assists such connection. The connection means may be mechanical or chemical in nature but must be durable taking into account environmental and plant conditions. For example, a chemical connection means such as an adhesive would require to be temperature resistant and resistant to small leakage or small plant concentrations of process materials. The connection means should allow water-tight sealing.

In a further aspect of the invention, there is provided an insulation system for insulating a component comprised of pre-formed modules, as described for the first aspect of the invention, adjacent modules being connected together by connection means to form the insulation system insulating the component.

In a still further aspect of the present invention there is provided a method of insulating a component comprising manufacturing pre-formed modules; and as described for the first aspect of the invention; and securing pre-formed modules to a component, or part of a component, and other modules to enable insulation of that component or part of the component.

Pre-formed modules making up the insulation may be connected to one or more adjacent module(s) and/or to the component or part of the component as above described.

In a still further aspect of the present invention there is provided a method of manufacturing an insulation module comprising forming a rigid insulation layer of insulating material; sealing the insulating material by application of a

sealing agent; forming a substantially non-fibrous cladding from cladding material; forming connection means on at least one of said cladding and said insulation layer; assembling the cladding and insulation materials; and forming the assembly into insulation modules for insulating components.

Conveniently, the sealing process is accomplished by spraying a sealing agent, onto the insulating material. Other sealing agents and methods of application to the insulating material could be employed.

Sealing agents found to be most useful include those based on acrylic emulsions such as JONCRYL 74F, a trade mark of Albright and Wilson, and PRIMAL RHA-691, a trade mark of Rohm and Haas Inc. Contained within such emulsions are fire retardants, advantageously alumina trihydrate, and stabilisers for preventing particles of fire retardant coming out of suspension. It may be useful for the flame retardant to be added at a level to constitute 60% by weight of a sealing film formed by the sealing agent on the insulating material. As a guide, a proposed sealing agent formulation would include:

Agent	Parts by Weight
JONCRYL 74F	450
Alumina Trihydrate	450
Propylene glycol	70
Carrybon L400 (Henkel)	27
Flexobrite Blue C5	6

The insulation and cladding materials may be shaped, say into a cylindrical or other suitably shaped pre-form with controlled thickness as required for effective insulation, and adhesive may be sprayed onto the surface of the cladding material to be adhered to the sealed matrix of insulating material.

In the case of insulation pre-forms these should be substantially uniform in composition and density across a given cross-section. The pre-forms should be unstriated, that is, not assemblages of plural narrow strips of material adhered together leaving striations at the adhered edges.

The adhesive agent is then applied to the pre-form of insulating material which is then adhered to the cladding material. It is also possible for the adhesive agent to be applied only to one of the insulating or cladding layers.

Other methods of application of adhesive or adhesion, that is fastening or connection, could be used in accordance with the invention.

The module, system and method of installation forming the various aspects of the present invention present cost and safety advantages over systems and methods currently employed for insulation. Insulation modules are also readily replaceable in the event of service failure.

The various aspects of the invention may be more completely understood from the following description of preferred embodiments thereof made with reference to the accompanying drawings in which:

Figure 1a is a side sectional view of a pre-formed module suitable for insulation of a length of pipe made in accordance with one embodiment of the present invention;

Figure 1b is an exploded view of two pre-formed modules showing the assembly;

Figure 2 is a perspective view of two pre-formed modules fitted together to insulate a portion of a pipe in accordance with a second embodiment of the invention;

Figure 3 is a front sectional view of a system of modules as shown in Figures 1 and 2 insulating a length of pipe;

Figure 4 is a front sectional view of a system of modules insulating a pipe fitting being an elbow; and

Figure 5 is a schematic flowchart of the manufacturing operation of an insulation module in accordance with the invention.

Modules

Referring now to Figure 1, there is shown an insulation module 10 fabricated in accordance with one embodiment of the invention. The module 10 is of semi-cylindrical shape suitable for use in the partial insulation of a pipe, partial because the insulation module will need to co-operate with further modules to completely insulate the pipe. Modules may be designed which allow insulation by a single module of hinged or analogous construction.

The module 10 has an insulation layer 14 and a cladding layer 18. These layers are, in the case of a semi-cylindrical module, substantially semi-

cylindrical and co-axial. The insulation layer 14 sits within the cladding layer 18 and a neat fit is envisaged though, in the embodiment shown, an adhesive agent is employed to secure assembly of the outer surface 14a of the insulation layer 14 and cladding layers 14 and 18. Inner surface 14c of insulation layer 14 is intended to contact a pipe to be insulated. A separate and distinct adhesive layer could be formed during manufacture. It will be seen that the cladding layer 18 is formed with greater circumferential extent than the insulation layer 14. The overlapping portions 18a are connection means designed to overlap circumferentially with the cladding layer 28 of another insulation module 20 of substantially similar construction to module 10 except that the insulation and cladding layers 24 and 28 are of substantially similar circumferential extent with contacting surfaces 14ba of insulation layer 24 formed substantially flush with longitudinal edges of cladding layer 28. Other connection means of mechanical or chemical nature may be employed instead of, or additionally to, the connection means or overlapping portions 18a described.

Thus module 10 is formed with circumferential beads 16 and 17; and module 20 with circumferential beads 26 and 27. The beads may be connected by longitudinally extending beads 126. Beads 16 and 26 are formed at ends 13 and 23 of modules 10 and 20. Beads 16, 17, 26 and 27, shown of V shape but other shapes are not excluded, strengthen the module and may act as water seals, preventing water ingress by capillary action. Beads 17 co-operate and engage with complementary portions of beads 27 to allow at least partial locking together of the modules 10 and 20 as suggested by Figures 1b and 2. These beads may have a further function as described below. In the embodiment shown, the portion 16a of bead 16, formed on overlapping portion 18a of cladding layer 18 of module 10, is generally V shaped presenting on the inner face 18b of overlapping portion 18a a V shaped channel which accommodates the complementary inverted V shaped bead 26 of module 20. Accommodation may involve an interference fit to achieve fastening but other connection means could be adopted. As shown in Figure 3, the connection of modules 10 and 20 may be made more secure by spot welding or riveting. Water sealing agents or tape may also be employed for water-tight sealing.

Modules 10 and 20 are designed such that the cladding semi-cylinders are of greater length than the insulation semi-cylinders. Thus at ends 11 and 21 of the modules 10 and 20 the cladding and insulation cylinders are co-terminous. At the ends 13 and 23, the cladding semi-cylinder extends past the end of the insulation semi-cylinder forming connection portions 19 and 29. These connection portions 19 and 29 are intended to overlap one end of adjacent insulation modules to be fastened thereto, as shown in Figure 3, in the manner typical of connection of pipes in the plumbing art. Beads 16 and 26 assist the fastening, in much the same manner as described above, with complementary beads on adjacent modules. Bead 126 may similarly co-operate with a corresponding longitudinal bead and be made water-tight. Welding or rivetting may be employed, particularly with the circumferential beads 16, 17, 26 and 27, to complete the job by forming a substantially continuous and complete insulation layer along the length of pipe or along the surface of a component to be insulated when the adjacent modules are correctly engaged. Fastening could also be achieved using screws or by strapping of the modules together by metal bands. The fastening is such as to achieve a water-tight seal. Joints may be taped with water-proof tape for this purpose or sealants, such as silicone sealants, may be employed.

Referring to Figures 1 to 3, and considering the modules 10 and 20 that have been described, the overlapped end portion of each module is marked 110 and 120 respectively. The connection portions 19 and 29 are of substantially the same length as the end portions 110 and 120 which are terminated at one end by beads 17 and 27. Connection portions 19 and 29 are intended to be slid over the end portions 110 and 120 of adjacent modules, for example 500 and 600, until prevented from further movement by beads 17 and 27. Thus beads 17 and 27 act as gauges during assembly showing that adjacent modules have been correctly secured together, the final fastening being made by riveting or spot welding or otherwise using water sealing agents and tape as appropriate. At this point, the insulation layers of the adjacent modules 10, 20 and 500 come into contact along their contacting surfaces 14d, secured if desired, forming a substantially continuous and complete insulation

layer along the length of the pipe. Gaps and breaks in the insulation are most advantageously to be avoided.

Modules 10 and 20, as described above, are suitable for insulation of substantially straight lengths of pipe. The modules may be customised for insulation of pipe fittings as well as other components. Figure 4 shows a series of insulation modules 30, 40, 50, 60, 70 and 80 shaped and cut to suit the radius and degree of a bend or elbow in a pipe to be insulated.

Method of Manufacture of Modules

The manufacture of the insulation modules 10 and 20 is shown schematically in Figure 5.

The material forming the insulation layer 14 may be supplied in the form of a hollow cylinder, of substantially uniform composition and density across a given cross-section. The hollow cylinder is cut substantially along a centre line thereof to allow formation of the insulation layer 14. The linear diameter of the cylinder and thus the insulation module 10 is selected to allow an engineered clearance to a pipe to be insulated.

The fibres making up a fibrous insulation material may be natural or synthetic, typically mineral, fibres such as fibreglass. It is such materials that have posed safety difficulties in on-site manufacture and installation in the plant. Cellular materials may also be employed, for example rigid cellular polyurethane foams as manufactured and supplied by the Applicant. Such materials may advantageously take the place of fibrous materials as described.

The cylindrical pre-form of the fibreglass may be sprayed with acrylic emulsions, for example as described above, or other suitable sealing agent to seal the insulating material. Sealing prevents escape of substantial quantities of fibres and unsatisfactory levels of such fibres in the insulation environment. Spraying could be replaced with alternative methods for applying the sealing agent, say dipping or brush application or other methods of application.

The application may be done before or after other manufacturing steps but typically prior to adhesion of the cladding material as prior application of the cladding layer may prevent proper sealing of the insulation material.

Typically the cladding material is metallic in nature, say of stainless steel,

coated steel or aluminium. Polymeric or composite materials could also be used. In other words, the cladding material should be resistant to plant conditions, particularly corrosion and temperature resistance. The cladding material may be painted and advantageously, in contrast to prior proposals, retains resilience when formed into a cladding layer of the pre-formed insulation modules 10 and 20.

The cladding is likewise pre-formed into cylindrical (or other shape) lengths though having greater outer diameter than that of the cylinder of insulating material, it being remembered that overlapping portions 18a must preferably be formed for one of the modules, module 10. Beads may be formed both circumferentially and longitudinally to assist in fastening as above described. The circumferential beads may intersect an axis of a module at any desired angle. The pre-form may then be cut to semi- or part- cylindrical or other suitable shape.

The finished modules 10 and 20 are formed by combination of adhesive and appropriate fitting techniques, for example neat or interference fitting techniques, to secure the insulation material within the cladding 18. A tight fit is desired. Loose fitting or loose packing of insulation material within cladding 18 is not advantageous. Following setting or curing of the sealing agent to seal the insulation material, the adhesive may be sprayed onto one outer surface 16 of the semi-cylinder of insulation material following which it may be fitted and adhered to the semi-cylinder of cladding material to which adhesive has also been applied on an inner surface of the cladding pre-form. Alternatively, the cladding material only may be sprayed or otherwise provided with a layer of adhesive, the insulation pre-form being pressed into position. Either the cladding or insulation materials or both could have an adhesive layer applied to them to allow adhesion. Any adhesive must be suitable for adhesion of metallic and fibrous materials. The adhesive must be suitable for durable use in the insulated environment. A solvent based adhesive sourced from Bostik under the trade name Bostik 1831 has been found suitable.

It is not absolutely necessary for adhesives to be used, the cladding and insulation layers 14 and 18 could be secured together by chemical bonding or

mechanical techniques. Nevertheless the use of adhesives is recommended for cost efficiency and practical reasons. Direct adherence is required for insulation efficiency. It is most important that the insulation and cladding layers 14 and 18 of the module 10 do not delaminate during transport to the site or before expiry of their service life.

The insulation modules 10 and 20 may be formed in lengths or customised to any particular component to be insulated, particularly for particular components, such as pipe fittings in a process plant though other applications for the modules may be envisaged. A kit of modules could be formed by cutting the lengths to smaller convenient sizes on-site or in the factory. These sub-modules are then available for installation at the plant. It may be understood that lengths and number of modules should be convenient for cost-effective transport to site.

In the case of a bend or elbow, as described in relation to Figure 4, suitably shaped pre-forms of fibreglass and cladding material to accommodate the elbow are obtained and assembled in the same manner of manufacture as modules 10 and 20 with cutting of the modules 30-80 to the requisite shape.

Method of Insulation

The installation method for a pipe or pipe fitting proceeds as follows. From design data, the pipe length is determined and insulating modules of the same kind as modules 10 and 20 described above are manufactured to allow insulation of that pipe. For a given length of the pipe, two semi-cylindrical modules are required. A greater number of modules could be used where pipe diameter suggests that modules of lesser circumferential extent than semi-cylindrical are more conveniently to be installed on the pipe. One module 20 is then press fitted onto the pipe. The other module 10 is likewise fitted onto the pipe with overlapping portions 18a of the cladding fitting over the surface of the first module 20 to connect them together on interference fitting of bead 16 within channel 26. Insulation layers 14, 24 of adjoining modules 10, 20 should contact along their contacting surfaces 14ba. The modules should advantageously also make contact with the component to be insulated. Welding or riveting or other fastening is employed to complete the job. This is especially done at the

circumferential beads though could also be done along the longitudinal beads 126. Water-tight sealing is advantageous. This may be achieved with water-proof tape and/or sealants such as silicone sealants.

Use of two modules is unlikely to insulate an entire pipe, other like modules are probably to be employed. In this case, adjacent modules must co-operate and be connected together to properly insulate the pipe. As has been described above, connection portions of modules 10 and 20 are overlapped with the end portions of an adjacent module and with each other suitably securing adjacent modules together to create a water seal particularly when supplemented by use of welding, rivetting and/or use of sealants and a substantially continuous and complete insulation layer along the length of pipe.

This process proceeds until the entire pipe is insulated. The invention is applicable to insulation of plant components other than pipes in which case design data is first sought for the component and pre-formed modules manufactured for the insulation job. The module(s) and systems may be utilised in concert with conventional insulation methods where design features of the plant recommend this.

Modifications and variations may be made to the present invention or consideration of the disclosure by the skilled reader of this disclosure. Such modifications and variations are considered to fall within the scope of the present invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A pre-formed insulation module having a part-cylindrical body including:

an unstriated insulation layer shaped to the body comprising a rigid insulating material and being substantially uniform in composition and density over a cross section of said layer; an inner surface adjacent to a surface of a component to be insulated; an outer surface generally concentric with said inner surface; and contacting surfaces;

a substantially non-fibrous, resilient cladding layer shaped to the body and directly adhered to the insulation layer at the outer surface thereof; and

connection means disposed along the length of the body for connecting with a further insulation module wherein said insulation and cladding layers of said module are disposed relative to each other such that , on connection to said further insulation module, insulation layers of said module and said further module are brought into contact along said contacting surfaces of the modules for insulating a portion of the component and wherein, when said insulating material is a fibrous material, fibres thereof are sealed by a sealing agent and are not specifically oriented relative to the modules.

2. The insulation module of claim 1 wherein said insulation layer is a dense unlaminated layer substantially comprised of a layer of rigid insulating material selected from the group consisting of rigid polyurethane foam, polyisocyanurate foam, and a fibrous material, preferably suitable for high temperature applications.

3. The insulation module of claim 1 or 2 wherein said module is a semi-cylindrical module with cladding layer overlapping said insulation layer along the length of the module on both sides of a longitudinal axis thereof such as to overlap with a cladding layer of said further module for at least partial connection therewith; and said module is provided along its length with circumferential beads.

Fig 1a.

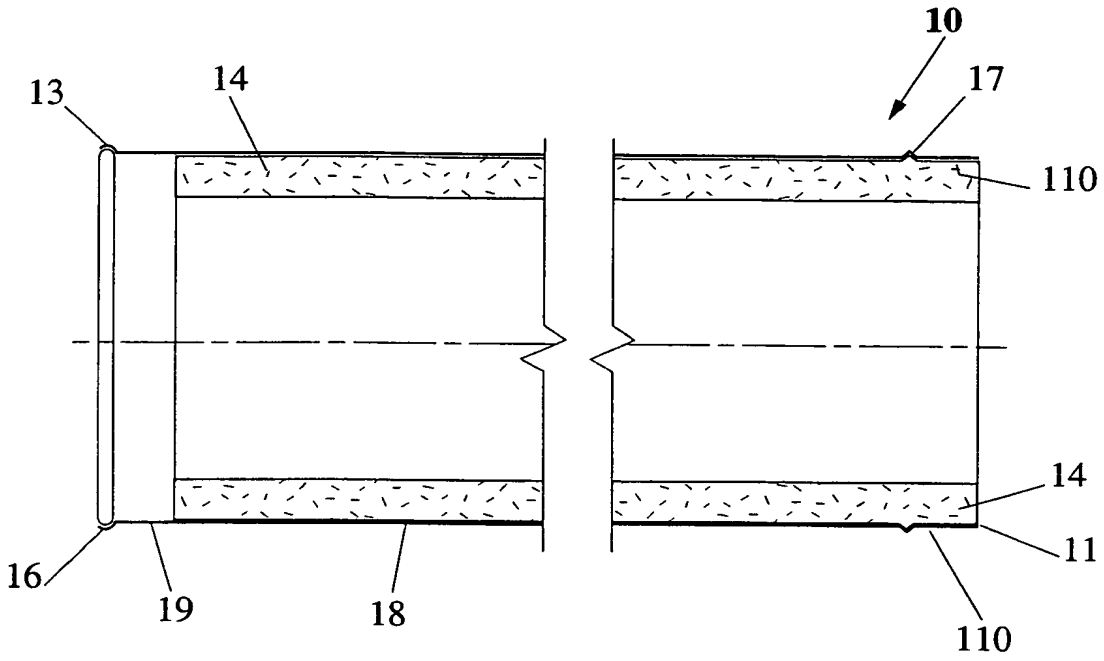
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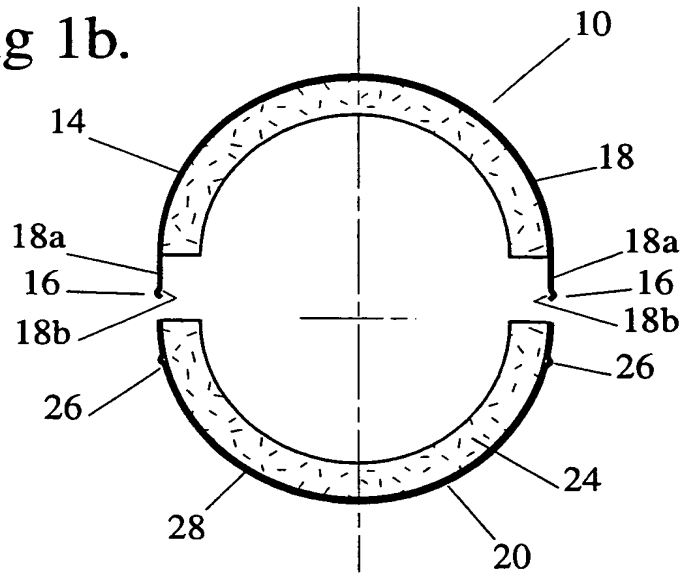
Fig 1b.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16
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18b
26
26
24
28
20

Fig 2.

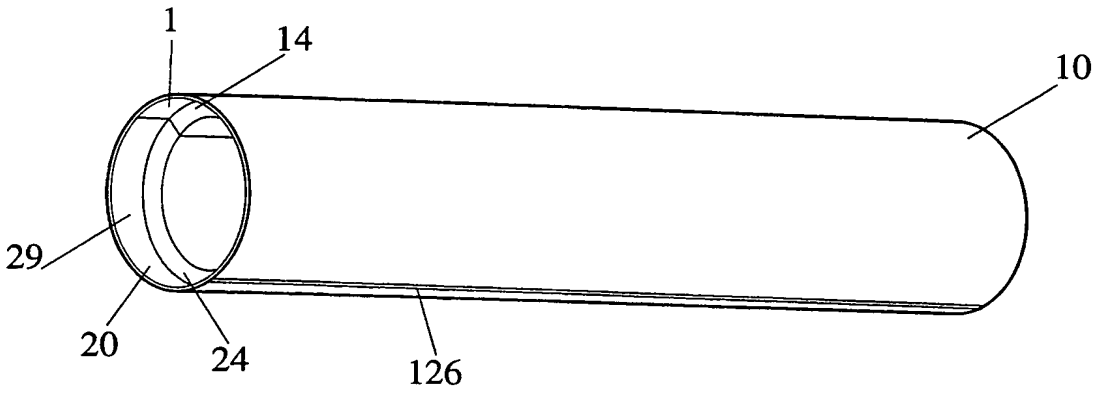


Fig 3.

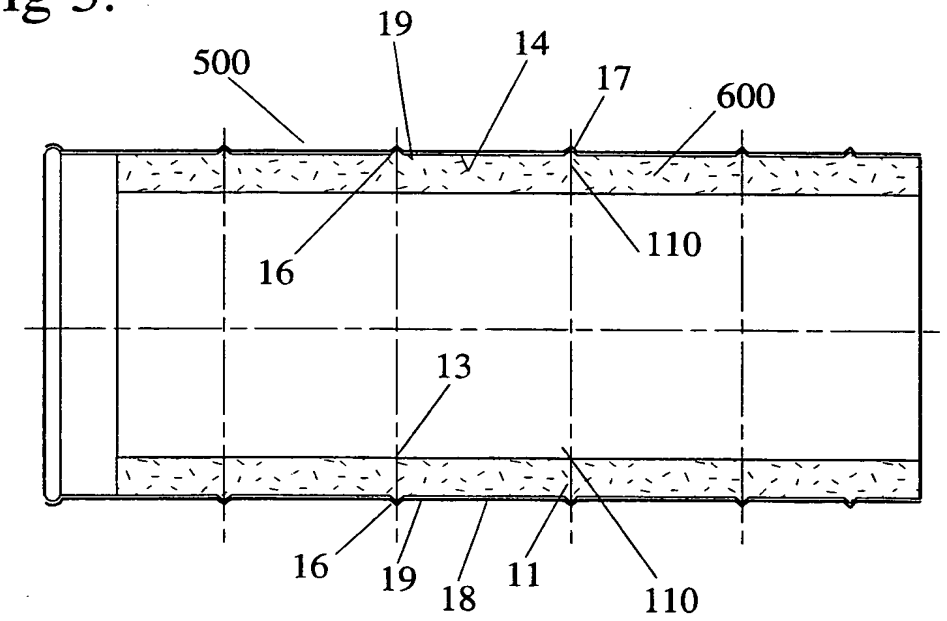


Fig 4.

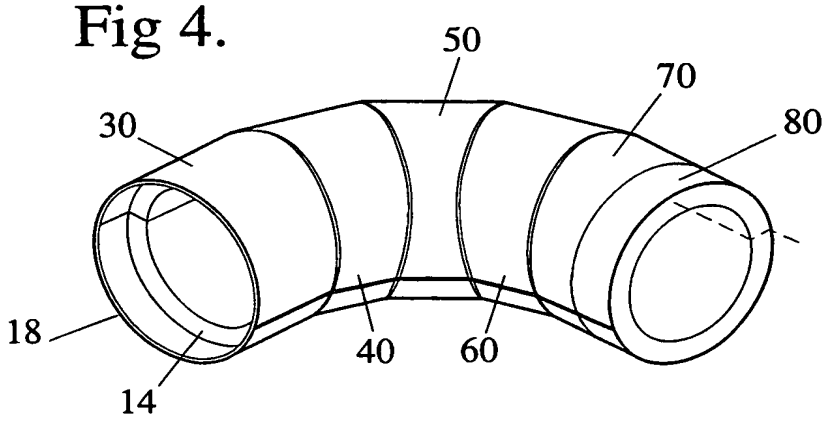
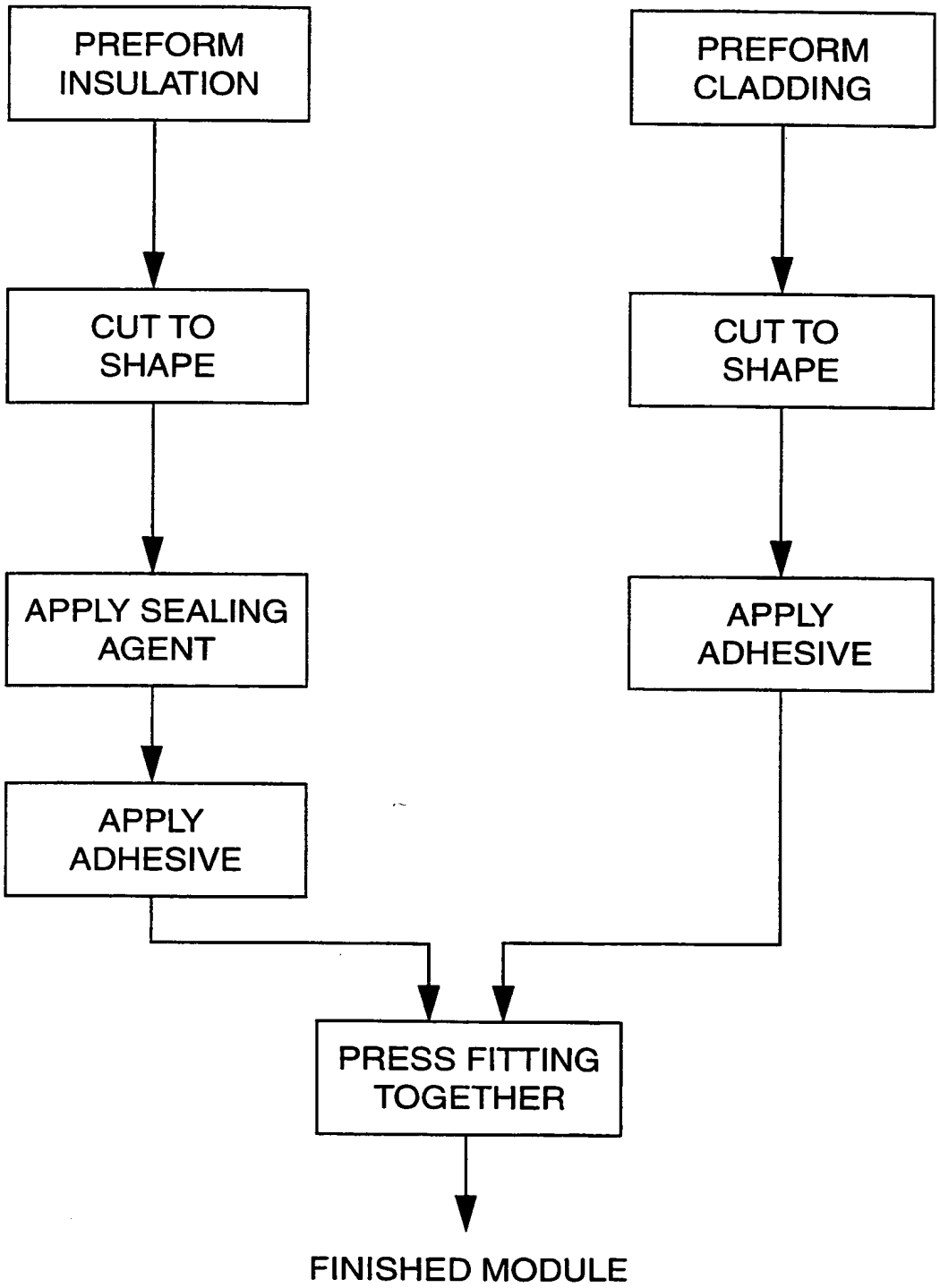


Fig 5.


PREFORM INSULATION
PREFORM CLADDING
CUT TO SHAPE
CUT TO SHAPE
APPLY SEALING AGENT
APPLY ADHESIVE
APPLY ADHESIVE
PRESS FITTING TOGETHER
FINISHED MODULE

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00328

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: F16L 59/02; 59/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: F16L 59/02, 59/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 59354/80 A (Williams) 8 January 1981 see pages 1-3 and 10-12 and Figure 60	1
X	GB 2283798 A (Coates) 17 May 1995 see whole document	1
X	DE 29706323 U (Steinbacher) 10 July 1997 see whole document	1

[X] Further documents are listed in the continuation of Box C

[ ] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
15 July 1999

Date of mailing of the international search report
27 JUL 1999

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Authorized officer
B.R. DASHWOOD
Telephone No.: (02) 6283 2121

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00328

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	US 3425456 A (Schilbig) 4 February 1969 see column 1 lines 1-53 and the Figures for examples of outer cladding with connection means along the body	1-3
Y	DE 3730357 A (Drespa) 23 March 1989 see whole document for examples of outer cladding and connection means along the body	1-3
Y	FR 1159733 A (Peylet) 1 July 1958 see whole document for examples of outer cladding and connection means along the body	1, 2
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Y	Derwent Abstract Accession No 96-023245/03, Class A88, JP 07-293786 A (Dai Nippon) 10 November 1995 see the use of polyurethane foam as insulator	1-3

PATENT COOPERATION TREATY

From the:
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

WATERMARK PATENT & TRADEMARK ATTORNEYS
4th Floor, Durack Centre
263 Adelaide Terrace
PERTH W.A. 6000

PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing *day/month/year*	22 MAR 2000
Applicant's or agent's file reference: RHB:JCC	**IMPORTANT NOTIFICATION**

International application No.	International filing date	Priority date
PCT/AU99/00328	4 May 1999	4 May 1998

Applicant
BAINS HARDING LIMITED

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translations to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide

Name and mailing address of the IPEA/AU	Authorized officer
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	B. R. DASHWOOD Telephone No. (02) 6283 2121

Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference RHB:JCC	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International application No. **PCT/AU99/00328**	International filing date *(day/month/year)* 4 May 1999	Priority Date *(day/month/year)* 4 May 1998
International Patent Classification (IPC) or national classification and IPC **Int. Cl.** [7] F16L 59/02, 59/14		
Applicant BAINS HARDING LIMITED		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

   [X] This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 6 sheet(s).

3. This report contains indications relating to the following items:

I	[X]	Basis of the report
II	[ ]	Priority
III	[ ]	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	[ ]	Lack of unity of invention
V	[X]	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	[ ]	Certain documents cited
VII	[ ]	Certain defects in the international application
VIII	[ ]	Certain observations on the international application

Date of submission of the demand 17 November 1999	Date of completion of the report 7 March 2000
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer B. R. HASTWOOD Telephone No. (02) 6283 2121

INTERNATIONAL PRELIM[redacted]RY EXAMINATION REPORT

[redacted]ernational application No.
PCT/AU99/00328

I. Basis of the report

1. With regard to the **elements** of the international application:*

☐ the international application as originally filed.

☒ the description, pages **1 and 5-13** as originally filed,
pages , filed with the demand,
pages **2-4** received on **28 February 2000** with the letter of **24 February 2000**

☒ the claims, pages , as originally filed,
pages , as amended (together with any statement) under Article 19,
pages , filed with the demand,
pages **14, 14a and 14b** received on **28 February 2000** with the letter of **24 February 2000**

☒ the drawings, pages **1-3** as originally filed,
pages , filed with the demand,
pages , received on with the letter of

☐ the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , received on with the letter of

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, was on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/fig.

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report*

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-10	YES
	Claims		NO
Inventive step (IS)	Claims	1-10	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-10	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

1. **AU 59354/80 A (Williams) 8 January 1981**

GB 2283798 A (Coates) 17 May 1995

DE 29706323 U (Steinbacher) 10 July 1997

Derwent Abstract Accession No 97-135373/13, JP 09-014578 A (Daiya) 17 January 1997

US 3425456 A (Schilbig) 4 February 1969

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US 2550465 A (Gorski) 24 April 1951

FR 2704930 A (Poujaud) 10 November 1994

US 2962402 A (Sweeney) 29 November 1960

Derwent Abstract Accession No 96-023245/03, JP 07-293786 A (Dai Nippon) 10 November 1995

None of these documents, either singly or in combination, disclose an insulation module that is pre-formed to have a body specifically shaped to a component to be insulated and wherein the insulation layer is unstriated and is made up of rigid fibrous insulating material with its fibres sealed against escape by a sealing agent producing a substantially uniform cross-section and with a substantially non-fibrous cladding layer adhered to the outer surface and with a hingeless connection means to allow one module to connect with at least one other module to encompass at least part of the component such that the respective insulating layers can contact each other.

Similarly, none of these documents disclose a method of manufacturing these pre-formed modules nor a method of insulating a component using these pre-formed modules.

As a consequence, the invention as defined in claims 1-10 is considered to be novel and to involve an inventive step in the light of these documents.

2. There is no evidence to suggest that the invention as defined in claims 1-10 does not have industrial applicability.

is installed. This may necessitate working in night environments where the costs of lighting and incidental costs of employment are commensurately higher than during the day.

Typical of such insulation materials are fibres, particularly man-made materials such as synthetic or natural mineral fibres. One such fibre typically used in chemical plants is fibreglass. The work restraints described above are very pertinent to this fibrous material.

It is the object of the present invention to provide insulation modules, systems and methods for the manufacture and installation of these which avoid, to the maximum practical extent, the cost and safety disadvantages of current techniques while achieving the insulation objective.

With this object in view, a first aspect of the invention provides a pre-formed insulation module having a body shaped to a component to be insulated including:

an unstriated insulation layer shaped to the body comprising a rigid fibrous insulating material having fibres sealed, having no specific orientation relative to the module, within said layer by a sealing agent and being substantially uniform in composition and density over a cross section of said layer which has an inner surface adjacent to a surface of a component to be insulated; an outer surface and contacting surfaces;

a substantially non-fibrous resilient cladding layer shaped to the body and directly adhered to the insulation layer at the outer surface thereof; and

connection means disposed along the length of the body for hingelessly connecting with at least one further adjacent insulation module wherein said insulation and cladding layers of said module are disposed relative to each other such that, on connection to said further insulation module, insulation layers of said module and said at least one further module are brought into contact along said contacting surfaces of the insulation layers of the modules for insulating at least a portion of the component.

By pre-formed is meant that the insulation module may be manufactured, as a complete insulating article, prior to transfer to, and installation at, a factory site. The factory site may be very remote to the site where the manufacturing plant is located. Such pre-fabrication of modules, which may be installed directly

at the site, saves significant site costs and reduces the cost of the insulation project.

The insulating material is a fibrous material. Fibres may be synthetic or natural and man-made mineral fibres are especially contemplated within the scope of the present invention. Alternatively, non-fibrous cellular materials such as polyurethane may be used as insulating material. The material may take any suitable rigid or flexible form, for example panels, mattresses or blankets.

Suitable materials may be selected from fibrous materials in rigid form, rigid polyurethane foam and polyisocyanurate foam. Modules may be designed with insulation materials suitable for high temperature applications as might be encountered in chemical plants and oil and gas refineries and installations where temperatures may be required to be maintained in excess of the boiling point of water.

The pre-formed module may be made up of any desired number of insulating layer(s) and any desired number of cladding layer(s). The insulating layers must include at least one layer of a fibrous material, but may include further layer(s) of insulating materials of same or different nature. Insulation materials may be blended together. The construction of the pre-formed module will be dependent upon the nature of the insulation job and the cost acceptability of the module.

The insulation module is provided with means to connect the module with another such module. Thus, in the case where the component to be insulated is a pipe or pipe fitting, such as an elbow or T-joint, a pre-formed module may cover a portion of the pipe or pipe fitting. That module is connected to another module or series of modules to complete the insulation of the pipe or pipe fitting.

Conveniently, the modules in this instance may be semi-cylindrical in geometry though the module may be a fractional cylinder of any desired circumferential extent. It may be found that semi-cylindrical modules are suitable for insulation of pipes to about 20Ó diameter, above that diameter the modules may be made a lesser fraction of a cylinder in circumference. That is it may be found more convenient to use more than two modules to insulate a

length of pipe. It will be understood that the module need not be limited in its application to the insulation of pipes and may not be circular or part circular.

In an advantageous embodiment, the pre-formed insulation module is a part-cylindrical module, say a semi-cylindrical module, with cladding layer overlapping the insulation layer along the length of the module on both sides of a longitudinal axis thereof such as to overlap with a cladding layer of a further module for at least partial connection therewith for insulating a component. The module may be provided along its length with circumferential beads and/or longitudinally extends to assist in connection to further modules for insulation of a component to be insulated.

Many components such as tanks may be insulated using similar pre-formed modules which need not be at all cylindrical in geometry. The determining factors in selection of the design of the module are as follows: the geometry of the component to be insulated, insulation requirements and cost.

The sealing agent sealing the mineral fibres must be such as to substantially contain the fibres in normal use, that is substantially preventing environmentally unacceptable (as dictated by standards or regulations) escape or detachment of fibres, during normal use. Many sealing agents may be suitable for this application, typically allowing a rigid fibrous material to be produced. They may be sprayed or otherwise applied to the mineral fibre product sourced from the mineral fibre supplier to achieve sealing. An acrylic emulsion has been found to be a suitable agent which is applied to the mineral fibre product by spraying.

The module may be manufactured in any convenient manner but generally the fibrous insulating material is cut to shape, that is the shape of the component, or part of a component to be insulated, sealed with the sealing agent and then adhered to a cladding material.

The cladding material may be formed from a metal such as stainless steel, coated steel or aluminium; or a polymeric material. The cladding material could be a composite material. It should be resistant to environmental and plant conditions. Typically, the cladding material would be formed into a resilient part-cylindrical sheet, that maintains some degree of resilience following fabrication

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A pre-formed insulation module having a body shaped to a component to be insulated including:

an unstriated insulation layer shaped to the body comprising a rigid fibrous insulating material having fibres sealed having no specific orientation relative to the module within said layers by a sealing agent and being substantially uniform in composition and density over a cross section of said layer which has an inner surface adjacent to a surface of a component to be insulated; an outer surface and contacting surfaces;

a substantially non-fibrous, resilient cladding layer shaped to the body and directly adhered to the insulation layer at the outer surface thereof; and

connection means disposed along the length of the body for hingelessly connecting with at least one further adjacent insulation module wherein said insulation and cladding layers of said module are disposed relative to each other such that , on connection to said further insulation module, insulation layers of said module and said at least one further module are brought into contact along said contacting surfaces of the insulation layers of the modules for insulating at least a portion of the component.

2. The insulation module of claim 1 wherein said module is a part-cylindrical module with cladding layer overlapping said insulation layer along the length of the module on both sides of a longitudinal axis thereof such as to overlap with a cladding layer of said further module for at least partial connection therewith; and said module is provided along its length with circumferential beads for location of a longitudinally disposed adjacent module.

3. A method for manufacturing an insulation module having a body shaped to a component to be insulated including:

an unstriated insulation layer shaped to the body comprising a rigid fibrous insulating material having fibres sealed, having no particular orientation relative to the module, within the layer by a sealing agent and being substantially uniform in composition and density over a cross section of said layer which has an inner surface adjacent to a surface of a component to be insulated; an outer surface; and contacting surfaces;

a substantially non-fibrous resilient cladding layer shaped to the body and directly adhered to the insulation layer at the outer surface thereof; and

connection means disposed along the length of the body for connecting with at least one further adjacent insulation module wherein said insulation and cladding layers of said module are disposed relative to each other such that, on connection to said further adjacent insulation module, insulation layers of said module and said at least one further module are brought into contact along said contacting surfaces of the insulation layers of the modules for insulating a portion of the component and which includes the step of taking a pre-form of a fibrous insulating material, cutting it to shape and applying to that pre-form, prior to cladding, a sealing agent for encapsulating fibres of said fibrous insulating material for preventing unacceptable release of fibres into the insulation environment during normal use.

4. The method of claim 3 further including adhering a metallic cladding layer free of fibres to the insulating layer following the sealing operation.

5. The method of claim 3 or 4 wherein said sealing agent is an acrylic emulsion.

6. The method of any one of claims 3 to 5 wherein said pre-form is at least part-cylindrical in shape.

7. A method of insulating a component comprising securing to that component a pre-formed insulation module having a body shaped to a component to be insulated including:

an unstriated insulation layer shaped to the body comprising a rigid fibrous insulating material having fibres sealed having no specific orientation relative to the module within said layer by a sealing agent and being substantially uniform in composition and density over a cross section of said layer which has an inner surface adjacent to a surface of a component to be insulated; an outer surface and contacting surfaces;

a substantially non-fibrous, resilient cladding layer shaped to the body and directly adhered to the insulation layer at the outer surface thereof; and

PCT/AU99/00328
Received 28 February 2000

connection means disposed along the length of the body for hingelessly connecting with at least one further adjacent insulation module wherein said insulation and cladding layers of said module are disposed relative to each other such that , on connection to said further insulation module, insulation layers of said module and said at least one further module are brought into contact along said contacting surfaces of the insulation layers of the modules for insulating at least a portion of the component; and connecting said module to at least one further adjacent module of like construction by co-operation of their respective connection means for insulating a portion of a component.

8. The method of claim 7 wherein said component is a pipe and said module is a part-cylindrical module with cladding layer overlapping said insulation layer along the length of the module on both sides of a longitudinal axis thereof such as to overlap with a cladding layer of said further module for at least partial connection therewith; and said module is provided along its length with circumferential beads for location of a longitudinally disposed adjacent module.

9. The method of claim 7 or 8 wherein said modules are interference fitted together.

10. The method of any one of claims 7 to 9 in which said inner surfaces of said module directly contact the insulated portion of said component.

DATED this 22nd day of February, 2000

BAINS HARDING LIMITED

WATERMARK PATENT & TRADEMARK ATTORNEYS
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263 ADELAIDE TERRACE
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00328

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: F16L 59/02; 59/14

According to International Patent Classification (IPC) or to both national classification and IPC

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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[X] Further documents are listed in the continuation of Box C

[ ] See patent family annex

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
15 July 1999

Date of mailing of the international search report
27 JUL 1999

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00328

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	Derwent Abstract Accession No 96-023245/03, Class A88, JP 07-293786 A (Dai Nippon) 10 November 1995 see the use of polyurethane foam as insulator	1-3

watermark

Please reply to Perth office

February 24, 2000

Our Ref: P2231PC00 RHB:JAH

Commissioner of Patents
IP Australia

Dear Sir,

Re: Patent in International PCT Application No. PCT/AU99/00328 by Bains Harding Limited

We refer to the Written Opinion dated 29 November 1999, and request that pages 2, 3, 4 and 14 be replaced with pages 2, 3, 4, 14, 14a and 14b as enclosed herewith in duplicate.

Description of the Amendment

The effect of the amendment is to further distinguish the claims from the prior art cited by the Examiner. Consequential amendments are proposed to the introduction of the specification, it being noted that all proposed amendments are supported by the description prior to amendment.

Particularly, it is proposed to amend claim 1 such that the insulating material is required to include a fibrous insulating material. The insulation module of the invention overcomes a problem of using fibrous insulation material for insulation applications in accordance with current methods in a time and labour efficient manner by use of pre-fabricated insulation modules that require only to be fitted and secured into place at the installation site. This problem is well described at page 1, line 30 to page 2, line 7, of the specification where it is disclosed that fibre release problems make fibreglass or fibrous insulation use difficult.

The claimed insulation modules avoid this problem because they are fabricated away from the application site. Problems of fibre release may therefore be substantially avoided.

It is to be noted that the body of the insulation module is shaped to components to be insulated. In the case of pipes, each module is part-cylindrical, generally semi-cylindrical. Two such semi-cylindrical modules are connected together, for example, to insulate a pipe section by connection means other than hinges. Thus the connection means are hingeless.

..../2

Patent and
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One further amendment might be noted. That is, a further two groups of claims are proposed to be added which are directed respectively, to a method of manufacturing the module; and a method for insulating a component using the particular modules claimed.

Discussion of the Prior Art

1. **DE 29706323; GB 2283798; JP 09-014578**

These references may be disregarded because fibrous materials as insulating materials are not disclosed. No sealing agent is applied to a fibrous insulating material to avoid fibre release to unacceptable extent within the insulating environment.

Unacceptable extent of such fibre release is dictated by environmental standards. Accordingly, these references are not directed to the problem that the invention, as presently claimed, solves. It may also be noted that GB 2283798 relates to a hinged construction.

2. **AU 59354/80**

While admittedly this reference is the closest reference it is to be noted that nearly all constructions involve hinged constructions. It is only where non-linear pipe fittings are to be insulated that split longitudinal half segments are employed. Even here (Figures 45 to 52) the connection is accomplished in a different way. It may be noted that the insulation layer is not shown in these drawings so it is not absolutely clear that the modular construction is adopted there (unlike many other of the drawings). The insulation module of the present invention is hingeless in all cases.

Still further and importantly, the reference does not teach that thermally inert fibreglass requires to be sealed with a sealing agent to prevent unacceptable fibre release during installation. So the reference does not solve the problem that the invention, as presently claimed, solves.

3. **US 3425456**

Nothing is said in this reference about the nature of the insulation layer. There is no teaching or suggestion that a fibrous insulation material sealed with a sealing agent to contain fibres is adopted.

If the insulation layer is not bonded to the cladding shell but is already in place on the pipe (for example), the cladding is positioned after insulation, presumably in a non-modular fashion. Thus the time saving achieved by using the present invention is lost. Put simply, this reference does not address modular insulation to limit installation time and prevent fibre release.

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4. **DE 3730357**

Nothing is said in this reference about fibrous insulation. Therefore, it is not clear that this document addresses the problem that the invention, as presently claimed, overcomes. It is not clear that the insulation layer is rigid and fibrous being substantially uniform in composition and density over a cross-section of the layer. Rather, it seems that the insulation – whatever its nature – may be loosely packed within the cladding shell or the cladding is not fabricated together with the insulation layer. That is, the reference may simply address post-insulation cladding in line with conventional on-site fabrication methods.

5. **FR 1159733**

The nature of the insulation material is unclear. It seems that rock wool may be present but there is no disclosure of any sealing agent to prevent escape of fibres, thus this pre-fabricated insulation module may still suffer fibre release problems that the present invention overcomes.

6. **US 2550465**

This document does not disclose a pre-formed insulation module, as claimed in the present invention. There is nothing said about a cladding layer and the nature of the connection means is unclear. It is uncertain that the body would be part-cylindrical in shape, or otherwise shaped to a particular process item to be insulated.

7. **FR 2704930; US 2962402 and JP 7-293786**

Similarly, references US 2962402, FR 2704930 and JP 7-293786 may be disregarded because fibrous insulating materials are not adopted and no sealing agent is applied to the fibrous insulating material. No problems, as dealt with by the present invention, are overcome in these references. US 2962402 also distinguishably discloses a hinged construction which may not contact a pipe or other item to be insulated.

Conclusion

Please reconsider the application in view of the proposed amendments and above remarks.

Yours respectfully,
WATERMARK

Richard H. Baddeley

Enc.

is installed. This may necessitate working in night environments where the costs of lighting and incidental costs of employment are commensurately higher than during the day.

Typical of such insulation materials are fibres, particularly man-made materials such as synthetic or natural mineral fibres. One such fibre typically used in chemical plants is fibreglass. The work restraints described above are very pertinent to this fibrous material.

It is the object of the present invention to provide insulation modules, systems and methods for the manufacture and installation of these which avoid, to the maximum practical extent, the cost and safety disadvantages of current techniques while achieving the insulation objective.

With this object in view, a first aspect of the invention provides a pre-formed insulation module having a body shaped to a component to be insulated including:

an unstriated insulation layer shaped to the body comprising a rigid fibrous insulating material having fibres sealed, having no specific orientation relative to the module, within said layer by a sealing agent and being substantially uniform in composition and density over a cross section of said layer which has an inner surface adjacent to a surface of a component to be insulated; an outer surface and contacting surfaces;

a substantially non-fibrous resilient cladding layer shaped to the body and directly adhered to the insulation layer at the outer surface thereof; and

connection means disposed along the length of the body for hingelessly connecting with at least one further adjacent insulation module wherein said insulation and cladding layers of said module are disposed relative to each other such that, on connection to said further insulation module, insulation layers of said module and said at least one further module are brought into contact along said contacting surfaces of the insulation layers of the modules for insulating at least a portion of the component.

By pre-formed is meant that the insulation module may be manufactured, as a complete insulating article, prior to transfer to, and installation at, a factory site. The factory site may be very remote to the site where the manufacturing plant is located. Such pre-fabrication of modules, which may be installed directly

at the site, saves significant site costs and reduces the cost of the insulation project.

The insulating material is a fibrous material. Fibres may be synthetic or natural and man-made mineral fibres are especially contemplated within the scope of the present invention. Alternatively, non-fibrous cellular materials such as polyurethane may be used as insulating material. The material may take any suitable rigid or flexible form, for example panels, mattresses or blankets.

Suitable materials may be selected from fibrous materials in rigid form, rigid polyurethane foam and polyisocyanurate foam. Modules may be designed with insulation materials suitable for high temperature applications as might be encountered in chemical plants and oil and gas refineries and installations where temperatures may be required to be maintained in excess of the boiling point of water.

The pre-formed module may be made up of any desired number of insulating layer(s) and any desired number of cladding layer(s). The insulating layers must include at least one layer of a fibrous material, but may include further layer(s) of insulating materials of same or different nature. Insulation materials may be blended together. The construction of the pre-formed module will be dependent upon the nature of the insulation job and the cost acceptability of the module.

The insulation module is provided with means to connect the module with another such module. Thus, in the case where the component to be insulated is a pipe or pipe fitting, such as an elbow or T-joint, a pre-formed module may cover a portion of the pipe or pipe fitting. That module is connected to another module or series of modules to complete the insulation of the pipe or pipe fitting.

Conveniently, the modules in this instance may be semi-cylindrical in geometry though the module may be a fractional cylinder of any desired circumferential extent. It may be found that semi-cylindrical modules are suitable for insulation of pipes to about 20Ó diameter, above that diameter the modules may be made a lesser fraction of a cylinder in circumference. That is it may be found more convenient to use more than two modules to insulate a

length of pipe. It will be understood that the module need not be limited in its application to the insulation of pipes and may not be circular or part circular.

In an advantageous embodiment, the pre-formed insulation module is a part-cylindrical module, say a semi-cylindrical module, with cladding layer overlapping the insulation layer along the length of the module on both sides of a longitudinal axis thereof such as to overlap with a cladding layer of a further module for at least partial connection therewith for insulating a component. The module may be provided along its length with circumferential beads and/or longitudinally extends to assist in connection to further modules for insulation of a component to be insulated.

Many components such as tanks may be insulated using similar pre-formed modules which need not be at all cylindrical in geometry. The determining factors in selection of the design of the module are as follows: the geometry of the component to be insulated, insulation requirements and cost.

The sealing agent sealing the mineral fibres must be such as to substantially contain the fibres in normal use, that is substantially preventing environmentally unacceptable (as dictated by standards or regulations) escape or detachment of fibres, during normal use. Many sealing agents may be suitable for this application, typically allowing a rigid fibrous material to be produced. They may be sprayed or otherwise applied to the mineral fibre product sourced from the mineral fibre supplier to achieve sealing. An acrylic emulsion has been found to be a suitable agent which is applied to the mineral fibre product by spraying.

The module may be manufactured in any convenient manner but generally the fibrous insulating material is cut to shape, that is the shape of the component, or part of a component to be insulated, sealed with the sealing agent and then adhered to a cladding material.

The cladding material may be formed from a metal such as stainless steel, coated steel or aluminium; or a polymeric material. The cladding material could be a composite material. It should be resistant to environmental and plant conditions. Typically, the cladding material would be formed into a resilient part-cylindrical sheet, that maintains some degree of resilience following fabrication

PCT/AU99/00328
Received 28 February 2000

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A pre-formed insulation module having a body shaped to a component to be insulated including:

an unstriated insulation layer shaped to the body comprising a rigid fibrous insulating material having fibres sealed having no specific orientation relative to the module within said layers by a sealing agent and being substantially uniform in composition and density over a cross section of said layer which has an inner surface adjacent to a surface of a component to be insulated; an outer surface and contacting surfaces;

a substantially non-fibrous, resilient cladding layer shaped to the body and directly adhered to the insulation layer at the outer surface thereof; and

connection means disposed along the length of the body for hingelessly connecting with at least one further adjacent insulation module wherein said insulation and cladding layers of said module are disposed relative to each other such that , on connection to said further insulation module, insulation layers of said module and said at least one further module are brought into contact along said contacting surfaces of the insulation layers of the modules for insulating at least a portion of the component.

2. The insulation module of claim 1 wherein said module is a part-cylindrical module with cladding layer overlapping said insulation layer along the length of the module on both sides of a longitudinal axis thereof such as to overlap with a cladding layer of said further module for at least partial connection therewith; and said module is provided along its length with circumferential beads for location of a longitudinally disposed adjacent module.

3. A method for manufacturing an insulation module having a body shaped to a component to be insulated including:

an unstriated insulation layer shaped to the body comprising a rigid fibrous insulating material having fibres sealed, having no particular orientation relative to the module, within the layer by a sealing agent and being substantially uniform in composition and density over a cross section of said layer which has an inner surface adjacent to a surface of a component to be insulated; an outer surface; and contacting surfaces;

a substantially non-fibrous resilient cladding layer shaped to the body and directly adhered to the insulation layer at the outer surface thereof; and

connection means disposed along the length of the body for connecting with at least one further adjacent insulation module wherein said insulation and cladding layers of said module are disposed relative to each other such that, on connection to said further adjacent insulation module, insulation layers of said module and said at least one further module are brought into contact along said contacting surfaces of the insulation layers of the modules for insulating a portion of the component and which includes the step of taking a pre-form of a fibrous insulating material, cutting it to shape and applying to that pre-form, prior to cladding, a sealing agent for encapsulating fibres of said fibrous insulating material for preventing unacceptable release of fibres into the insulation environment during normal use.

4. The method of claim 3 further including adhering a metallic cladding layer free of fibres to the insulating layer following the sealing operation.

5. The method of claim 3 or 4 wherein said sealing agent is an acrylic emulsion.

6. The method of any one of claims 3 to 5 wherein said pre-form is at least part-cylindrical in shape.

7. A method of insulating a component comprising securing to that component a pre-formed insulation module having a body shaped to a component to be insulated including:

an unstriated insulation layer shaped to the body comprising a rigid fibrous insulating material having fibres sealed having no specific orientation relative to the module within said layer by a sealing agent and being substantially uniform in composition and density over a cross section of said layer which has an inner surface adjacent to a surface of a component to be insulated; an outer surface and contacting surfaces;

a substantially non-fibrous, resilient cladding layer shaped to the body and directly adhered to the insulation layer at the outer surface thereof; and

connection means disposed along the length of the body for hingelessly connecting with at least one further adjacent insulation module wherein said insulation and cladding layers of said module are disposed relative to each other such that , on connection to said further insulation module, insulation layers of said module and said at least one further module are brought into contact along said contacting surfaces of the insulation layers of the modules for insulating at least a portion of the component; and connecting said module to at least one further adjacent module of like construction by co-operation of their respective connection means for insulating a portion of a component.

8. The method of claim 7 wherein said component is a pipe and said module is a part-cylindrical module with cladding layer overlapping said insulation layer along the length of the module on both sides of a longitudinal axis thereof such as to overlap with a cladding layer of said further module for at least partial connection therewith; and said module is provided along its length with circumferential beads for location of a longitudinally disposed adjacent module.

9. The method of claim 7 or 8 wherein said modules are interference fitted together.

10. The method of any one of claims 7 to 9 in which said inner surfaces of said module directly contact the insulated portion of said component.

DATED this 22nd day of February, 2000

BAINS HARDING LIMITED

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PATENT COOPERATION TREATY

INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

WRITTEN OPINION

(PCT Rule 66)

To:

Watermark Patent & Trademark Attorneys
4th Floor, Durack Centre
263 Adelaide Terrace
PERTH WA 6000

Date of mailing *(day/month/year)*	29 NOV 1999
Applicant's or agent's file reference. RHB:JCC	**REPLY DUE** within **TWO MONTHS** from the above date of mailing

International application No.	International filing date *(day/month/year)*	Priority Date *(day/month/year)*
PCT/AU 99/00328	4 MAY 1999	4 MAY 1998

International Patent Classification (IPC) or both national classification and IPC

Int. Cl.[6] F16L 59/02, 59/14

Applicant

BAINS HARDING LTD

1. This written opinion is the **FIRST** (first, etc) drawn by this International Preliminary Examining Authority.
2. This opinion contains indications relating to the following items:.

I	[X]	Basis of the opinion
II	[ ]	Priority
III	[ ]	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	[ ]	Lack of unity of invention
V	[X]	Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	[ ]	Certain documents cited
VII	[ ]	Certain defects in the international application
VIII	[ ]	Certain observations on the international application

3. The applicant is hereby **invited to reply** to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also For an additional opportunity to submit amendments, see Rule 66.4. For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4*bis*. For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: **4 SEPTEMBER 2000**

Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No. (02) 6285 3929	Authorized Officer **B. R. DASHWOOD** Telephone No. (02) 6283 2121

WRITTEN OPINION

International application No.
PCT/AU 99/00328

I. Basis of the opinion

1. With regard to the **elements** of the international application:*

[X] the international application as originally filed.

[ ] the description, pages , as originally filed,
pages , filed with the demand,
pages , filed with the letter of .

[ ] the claims, pages , as originally filed,
pages , as amended under Article 19,
pages , filed with the demand,
pages , filed with the letter of .

[ ] the drawings, pages , as originally filed,
pages , filed with the demand,
pages , filed with the letter of .

[ ] the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , filed with the letter of .

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:

[ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

[ ] the language of publication of the international application (under Rule 48.3(b)).

[ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the written opinion was drawn on the basis of the sequence listing:

[ ] contained in the international application in printed form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readable form.

[ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. [ ] The amendments have resulted in the cancellation of:

[ ] the description, pages

[ ] the claims, Nos.

[ ] the drawings, sheets/fig.

5. [ ] This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed"*

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	2, 3	YES
	Claims	1	NO
Inventive step (IS)	Claims		YES
	Claims	1-3	NO
Industrial applicability (IA)	Claims	1-3	YES
	Claims		NO

2. Citations and explanations

1. **AU 59354/80 A (Williams) 8 January 1981**
GB 2283798 A (Coates) 17 May 1995
DE 29706323 U (Steinbacher) 10 July 1997
Derwent Abstract Accession No 97-135373/13, JP 09-014578 A (Daiya) 17 January 1997

These documents disclose all of the features of claim 1 in that they disclose a pre-formed insulation module having a part cylindrical body having a unstriated insulation layer shaped to the body comprising rigid insulation material of substantially uniform composition and density; with an inner surface adjacent the component to be insulated and an outer surface concentric with the inner surface and with contacting surfaces; a substantially non-fibrous resilient cladding layer shaped and adhered to the outer surface; and connecting means disposed along the body to connect the modules and make respective contact by means of the contacting surfaces. Various means are disclosed for the "connecting means" as shown in **AU 59354/80** (snap connectors 109/110 in Figure 10); **GB 2283798** (wrap-around and overlapping silicone sheet); **DE 29706323** (wrap-around cover with overlapping cover strip) and **JP 09014578** (shaped attachment surfaces that can be adhered together).

As a consequence, it is considered that the invention as defined in claim 1 is not novel and does not involve an inventive step in the light of these documents.

2. **US 3425456 A (Schilbig) 4 February 1969**
DE 3730357 A (Drespa) 23 March 1989
FR 1159733 A (Peylet) 1 July 1958

These documents all disclose examples of systems involving outer cladding integers having connection means along their length, any one of which can be combined with one or more of:

US 2550465 A (Gorski) 24 April 1951
FR 2704930 A (Poujaud) 10 November 1994
US 2962402 A (Sweeney) 29 November 1960
Derwent Abstract Accession No 96-023245/03 JP 07-293786 A (Dai Nippon) 10 November 1995

These documents disclose various possible constituents for the insulating layer exemplified by **US 2550465** (resin-sealed fibrous materials); **US 2962402** (foamed polymer materials) and **FR 2704930 and JP 07-293786** ([rigid] polyurethane foam). These citations could be combined, as would be obvious by a person skilled in the art, to disclose all of the features of the claims.

As a consequence, it is considered that the invention as defined in claims 1-3 does not involve an inventive step in the light of these documents.